Geek goddesses go to school: A study of female pre-service teachers in information technology courses

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Various reasons have been proffered for female under-representation in tertiary information technology (IT) courses and the IT industry with most relating to cultural moirés. The 2006 Geek Goddess calendar was designed to alter IT's "geeky image" and the term is used here to represent young women enrolled in pre-service IT teaching courses. Their special mix of IT and teaching draws on conflicting stereotypes and represents a micro-climate which is typically lost in studies of IT occupations because of the aggregation of all IT roles. This paper will report on a small-scale investigation of female students (N=25) at a university in Queensland (Australia) studying to become teachers of secondary IT subjects. They are entering the IT industry, gendered as a "male" occupation, through the safe space of teaching a discipline allied to feminine qualities of nurturing. They are "geek goddesses" who – perhaps to balance the masculine and feminine of these occupations - have decided to go to school rather than into corporations or government.

The under-representation of women in the IT (information technology) industry and their low levels of enrolment and high levels of attrition in university IT courses have been of longstanding concern (Bennett, 2000; Margolis & Fisher, 2002; Trauth, Nielsen, & von Hellens, 2003; NSW DfW, 2001; Wardle & Burton, 2002). These concerns have been revived of late in the wake of the dot.com crash, falling employment opportunities and collapsing overall enrolments in IT courses across the world (Ramsey & McCorduck, 2005; State of Victoria, 2001, 2007). There are now fears of projected shortages of IT professionals and it has been argued that such shortages "could be greatly reduced if more female and minority students would major in IT disciplines, yet the dramatic under-representation of these populations appears to be worsening" (Agosto, Gasson, & Atwood, 2008, p. 205). The spotlight – after an arguable gap in the research literature – has again turned to how to attract and retain young women to and in the IT industry.

This paper will report on a small-scale investigation of the experiences of female students (*N*=25) at a university in Queensland (Australia) who were studying to become teachers of secondary IT subjects. They are entering the IT industry, gendered as a "male" occupation (Rettenmayer, Berry, & Ellis, 2007; Tapia & Kvasny, 2004; Wajcman, 1991, 2004), through the safe space of teaching, a discipline more typically allied to feminine qualities of nurturing. They are "geek goddesses" who – perhaps to balance the male and feminine of

these occupations - have decided to go to school rather than into corporations or government.

Background to the study

Enrolments in secondary and tertiary IT courses having been falling for the last decade. In considering why 14-19 year old students – both male and female - were not interested in pursuing studies or a career in IT, a major Australian study found that:

i. Most students have a very limited view of IT as the computer, keyboard and peripherals rather than the "social" and "entertainment" technologies they enjoy.

ii. Students are aware of the opportunities and money in IT but generally did not care. They were more motivated to pursue careers linked to personal interests.

iii. Students see jobs involving technology as technical rather than creative, and solitary rather than team-oriented.

iv. IT was seen as limiting future options – a direct route to spending work time glued to a monitor and keyboard.

(State of Victoria, 2001, p. 4)

Various reasons have been proffered for low female participation in the IT industry with most relating to cultural moirés (Cohoon & Aspray, 2006; Jepson & Perl, 2002; Margolis & Fisher, 2002; Ramsey & McCorduck, 2005; Varma, 2007). Their reluctance to undertake IT studies at secondary school (and leading into tertiary study) appears to lie in girls' belief that ICT courses lack interest, are "boring," and are incompatible with their preferred career paths (Timms, Courtney & Anderson, 2006). Elsewhere, reasons included preference to other offered subjects, limited interest in the content, or being perceived as being "too hard" or, again, "boring" (State of Victoria, 2007, p. 14).

A recent attempt to attract more females to take up courses and careers in IT was the publication in Australia of the 2006 "geek goddess" calendar designed to alter the industry's "geeky image and encourage young women to consider a computing career" (AAP, 2006, para. 1). The calendar – sponsored by Australian Women in IT (AWIT) group - shows young female IT professionals in provocative poses inspired by screen images (see Figure 1). The drive to "feminise" the IT industry has been extrapolated in this instance – in a skewed way – to commodifying these women as sex objects. One wonders if young

women are more comfortable with the "geek" than the "goddess" or, more pertinently, with more contemporary powerful images of "girlpower" (Harris, 2003).

Figure 1: Geek goddess calendar (AAP, 2006)

The term "geek goddesses" is appropriated in this paper as a descriptor for contemporary women trying to find a genuine identity in IT. In this instance, as noted, the goddesses are on their way to school, that is, they are training to be secondary classroom teachers specialising in information technology (informatics) subjects. Their feminising of the industry has privileged the concept of nurturing and socialisation over the more overt sexual aspects of the female "goddess" stereotype. Their version of girlpower is in tackling the "harder" aspects of computing, that is, networking, programming and database design. The classrooms they are entering represent one of the "micro-climates" of the IT industry often lost in studies because of the aggregation of all IT roles into one classification (Ramsey & McCorduck, 2005).

The IT culture has been uncompromisingly described as being:

> … largely white, male-dominated, anti-social, individualistic, competitive, all-encompassing and non-physical. This ascetic culture has strong in-group and out-group dualisms in which the needs of the disembodied intellect subsume emotional, physical and sensual needs. This dualism translates into expert and non-expert and to male and female behaviours, attitudes and values.
>
> (Tapia & Kvasny, 2004, p. 84)

The othering of women – or female behaviours – in Tapia and Kvasny's (2004) description and the curiously skewed feminisation of the women in the calendar perhaps provide their own answers to the low representation of women in the industry. The description of the hegemonic male identity central to this culture is akin to the mature or adult form of the geek stereotypically described as being:

> … a bright young man turned inward, poorly socialized, who felt so little kinship with his own planet that he routinely travelled to the ones invented by his favourite authors, who thought of that secret, dreamy place his computer took him to as cyberspace—somewhere exciting, a place more real than his own life, a land he could conquer, not a drab teenager's room in his parents' house.
>
> (Smith, cited in Chen Christensen, 2006, para. 3)

Some studies have reported that there are few positive role models in place to dismiss the negative perceptions and stereotypes of the IT industry (Agosto, et al., 2008; Jepson & Perl, 2002). This is particularly relevant as positive role models have been cited as being a major factor in young women's career decision-making (Adya & Kaiser, 2005) and that the absence of visible female role models serves more generally to alienate young women from careers in science and technology (Kekelis, Ancheta & Countryman, 2005). An Australian study found that a majority of female IT students could not name any female IT role models (Thomas & Allen, 2006). These findings gain significance for the young women in this study – the geek goddesses who have gone to school – as potential "role models" to a future generation of young women.

It is self-evident that teaching has long been culturally perceived as a feminine occupation, with Apple (1985) categorising it as "women's work." Studies have shown that females prefer careers with social interaction and the opportunity to solve human problems (Agosto, 2001; Beyer, Rynes & Haller, 2004) and that they are rarely interested in technology for its own sake (Agosto, 2001; Turkle, 1988). This would seem to rule out IT as a career on the basis of the previously cited perceptions of the IT industry as isolating (State of Victoria, 2001, 2007) and the finding that "females' deep interest in human communication and human relationships stands at odds with their view of computer scientists as working in social isolation" (American Association of University Women, cited in Agosto et al., 2008, p. 210).

The focus of this study was on a specific cohort of young women in IT and following their experiences of melding two disparate careers and in making decisions about which path they should follow. It thus addresses a "micro-climate" of the IT industry previously left unexamined and looks further into the cultural perceptions of careers as disincentive for participation.

Method

The qualitative study described in this paper is informed by critical ethnography (after Thomas, 2003). The researcher – in her role as supervising lecturer to the young women in the study - aimed to use the research itself as the means to emancipating them from cultural stereotypes and seeking to support their finding their own identity against taken-for-granted "realities." The achievement of this goal was noted in an email from one of the respondents, Laura, who offered that:

> *When reviewing the* [survey] *… questions, I was unexpectedly acquainted with past memories that I had forgotten. Before these questions, I was under the illusion that I have never been tainted by gender inequity. Now I wonder. Do you want the long version or the short. Here it goes!*

The study was based on three simple research questions:

1. Why have these young women become computer geeks, that is, involved in programming and database design rather than generic applications such as word processing?
2. Why have they chosen to become teachers – involved with adolescent students in a classroom rather than the IT industry?
3. What of their experiences in adopting a "male" discipline in a "female" profession?

The data for this study, as for other typical studies of female participation in IT, was drawn from informal interviews, surveys and observation (Barker & Aspray, 2006; Gannon, 2007). The main item for data collection was a five-item survey sent by email to all females enrolled in either a double degree (IT/Education) program or a standalone Bachelor of Education (with an IT specialisation). Data analysis was by open coding of the textual responses and collation into themes. This paper will present findings from two of the five items in the survey. Further findings are presented elsewhere (see, for example, Lloyd, in press).

All respondents to the study (N=25) were women enrolled in IT curriculum studies supervised by the researcher. All but two were aged between 20-24 years of age. The exceptions were (a) Laura, 33 years of age, a career-change entrant with two young children; and (b) Irene, 46 years of age and returning to study after raising a family. The respondents were from differing stages in their course, that is, in the second, third and fourth year of their program. Course progression had no apparent impact and was not used as a qualifier in this paper. All had experienced at least one period of field studies as a pre-service or student teacher.

Findings

The findings are presented in this paper under two main headings: (i) girls as geek goddesses, and (ii) geek goddesses as teachers. Extracts presented in this section are taken verbatim from survey responses or email correspondence. Pseudonyms have been given to those cited in this paper.

Girls as geek goddesses

The study aimed initially to uncover the attraction or affinity the young women felt for IT as a discipline in and of itself. The first survey item directly asked: *Why IT? What has interested you, supported you, or inspired you to get into this field?*

The responses to this item indicated that the subjects' interest in IT had been aroused at either school or home. Where the impetus was credited with "school" (*n*=8, *N=25*), the responses usually cited a particular teacher, year level or activity and were phrased in warm and encouraging ways. A typical response was:

> *From an early age I loved playing on computers. In Grade 3, we did a very basic computer moderated typing course which I enjoyed and in late primary we had a computer in our room which we were able to use to play an educational game – one time I got to take the computer home, which at the time was really exciting. It wasn't until Grade 11 that I really knew I wanted to go into the IT field. I was in an IPT class* [senior secondary subject, Information Processing and Technology] *that had only a few girls and my IPT teacher encouraged me, such that I was able to do really well in the class. I loved developing information systems and creating programs, and the ability was supported.* [Heather]

Bridget explained that she came "from a family of two girls, and we got our first computer when I was in Year 2. I also went to a private girls' school which encouraged the use of computers." Her experience aligns directly with the two significant factors identified by von Hellens and Nielsen (2001) in the backgrounds of women deliberately choosing careers in IT. These were (i) attendance at a single-sex school, and (ii) support from parents (at least one of whom worked in a technical area). The first of these factors, that is, attendance at single-sex school had not been directly questioned in the survey but emerged voluntarily in four responses to the final survey item. For example, Gillian noted that:

> *Today I realise the IT industry is very male dominated; however I went to an all girls' school and IPT was offered and obviously just filled with girls. Therefore I had access to these technologies and I thought it was the norm. Then I just continued into uni following IT.*

The second factor, that is, "support from parents," was similarly not directly questioned in the survey. Yet it emerged from the beginning as a significant finding. While only five respondents had explicitly cited "home" in response to the first survey item, it became increasingly important (through frequency) throughout responses to other survey items. The incidental nature of the references to home experience – as in Bridget's explanation - was itself of interest and elsewhere included such comments as:

- *I have been playing with them* [computers] *since primary school (Commodore 64) and helping Dad create little Dr Who programs on it. Loved doing this since then! With my parents interested in using computers and having it at home, I had easy access to them when I wanted to. I even managed to keep them from using it at times.* [Julie]
- *My father bought me a Commodore 64 when I was 13; a competent wagger, bullied, fat and craving a friend. I was thrilled and read every page of the instruction booklet until I knew how to play every monochrome game I could find! … Having 2 older brothers and a dad who loves gadgets, I have never been intimidated by tools or technical instructions.* [Laura]
- *I have always been interested and enjoyed using computers. My father was heavily into them, and I remember the focus of this (old DOS games like volleyball where two furry aliens played) throughout my childhood. So I would say my dad's introduction of computers to me made it a hobby of mine. As such, I developed strengths and interests in computers and this lead to excelling and enjoying it during high school, naturally leading to this being part of my tertiary ed. career.* [Felicity]

With only one exception, Alice – whose sister worked as a contract programmer – all cited mentors were male (fathers or brothers). The consistent memory, however, was of fun and achievement. The previously cited notions of difficulty or boredom extant in the findings of large-scale studies were not evident in the girls' responses.

Geek goddesses as teachers

The second item in the survey asked: *Why then IT teaching rather than a career in the IT industry? Is this a "lesser" choice? What does teaching have as a career that the IT industry itself might not?*

The notion of teaching as a "lesser choice" is significant if we accept that occupations are gendered (Heidensohn, 1994; McCulloch & Schetzer, 1993) and then infer that the male IT occupation has a higher status than the feminised occupation – or vocation – of teaching. In Australia, an estimated 69.0% of the teaching force is female (80.4% of all full time primary teachers and 57.3% of all full time secondary teachers) (ABS, 2009). Given this ratio, which is steadily increasing, and the perception that IT companies do not offer "favourable

environments for women" (Perelman, 2007), a young woman in an IT course saying she is going into teaching is unlikely to be challenged. The dilemma of teaching versus industry is clear in Felicity's response:

> *Sometimes I think I'm playing it really safe by teaching, as it is easier, and less scary than the unpredictable world (and the unknown world) of what IT companies want from me, or expect of my skills. However thinking about this now, I know that compared to other students and teachers even, I can teach and engage students extremely well. … So yes, while I think I am copping out by the safe environment and the 'easy' work (which isn't always true in a class of 25 kids who just have all decided today they don't feel like working), maybe teaching is a special thing that not everyone can do.*

The overwhelming majority of respondents had seemingly resolved this dilemma and reported strong emotive feelings about teaching as a positive worthwhile career. For example, Alice, offered that:

> *I do not feel that teaching is the lesser choice at all. Teaching suits various people more than coding might. As for me, I find more satisfaction in listening to a student finally grasping an important point in class than scrambling up a corporate ladder to find success. I am most comfortable, and happy in the classroom, and that is where I will stay for years to come.*

Another, Annie, offered emphatically that:

> *I get more enjoyment from teaching others how to do awesome stuff with computers than just doing it myself (although that is fun too). In no way is teaching a "lesser choice." I've always hated that saying which says "those who can do, those who can't teach" because if you can't do something there's no way you can teach it. I like to rephrase it to say "Those who can do, those who understand teach." Teaching offers a great opportunity to spread understanding that will help people do more with their lives.*

Another, Gillian, offered her perceptions of teaching in contrast to the IT industry by saying that:

> *To me it doesn't seem a lesser choice, however I know if I was involved in the IT industry more money can be offered. Other fields in IT seemed… well – the whole IT industry to me is a very solo career. Yes you talk to others, but much of the work and pressure involves just you and the computer.*

In almost direct contrast to this was a comment from Bridget, a double degree student, who offered a negative reaction (to teaching). She wrote that:

> *I actually think that it is a lesser choice, and it is for this reason that I have chosen not to teach IT in schools, but to focus on the business sector. Teachers aren't valued, and although they are experts in teaching, most are not experts in their subject area. I can't understand why a person who is very good at IT would want to teach. To me, it is a waste of skills.*

Bridget had elsewhere reported that "when on prac, the network technicians found out that I had a degree in IT, and asked me why I was wasting my time with an Education degree when I could be making good money in IT!" This would suggest a perception within the IT industry that teaching is a "lesser option" and that (exclusively male) network technicians in schools have a low opinion of the teachers they ostensibly support. Direct observation would indicate that this sense is not gender-related, but more about how teaching itself is perceived. It is anecdotally known that male IT teachers are often asked directly by students (and peers) why they are in school rather than a corporate position.

A more positive story (and one seemingly against this trend) came from Heather, another double-degree student who had re-considered her future following a successful practicum. She wrote that:

> *Originally I saw teaching as a fall back, a second hope if I didn't get a job in the IT industry. But once I started practical teaching, I found out just how great it is to help others develop their skills in IT, or find a new pathway in IT that they hadn't thought about before. Also, teaching is a lot more than just giving students knowledge and skills, it's about encouraging each student to become all that they can. A 9 to 5 IT job, where you see a few people in the office, occasionally have a social meeting with them doesn't seem to be as important or rewarding.*

Heather had, in conversation earlier in the academic year, admitted that she was going to apply for an IT job when she graduated "to develop her skills." That she had subsequently reconsidered implied that she had greater confidence in her skills and had established what for her were the critical qualitative differences between educational and corporate environments. What is of particular interest here is that she did not have support from her family. She responded to one of the survey items by offering that:

> *Pretty much all my family tried to sway me from the Education sector as they believed I was not doing all that I was capable of, but basically it all boiled down to the money issue. They also have the perception that an office-type management job is more highly regarded. They don't see that each day in teaching you have the potential to build a child's self-esteem, by encouraging them socially and academically.*

Heather's choice of IT teaching as a career was one she had had to actively defend within her own family. That her resolve was so clear was extraordinary given what must be an ongoing discussion and call to her to defend her choice of career.

Two of the young women who responded to the survey candidly offered that they did not achieve the required OP (the final Year 12 result in Queensland) to get into an IT degree course, and had opted for secondary teaching with a major in IT as a alternate career path in the area. One of these, Kate, recorded that she now felt confident enough (and would have the pre-requisites) to do further study in IT. This, interestingly, was the direction she adopted and later credited her involvement in the study as the catalyst to her changing her University course and career. As with the previously cited comment by Laura, answering the survey was a catalyst to resolving career decisions and definitions of personal identity.

Discussion

This paper began by briefly reviewing the stereotypes of the IT industry, the male "geek," and a curious – and unrepeated – attempt to create a new stereotype of the Geek Goddess to replace images of bespectacled unfashionable female geeks. In their stead, the paper has presented some "real" young women who are competent in IT but have chosen a different path albeit one with its own stereotypes and cultural perceptions. When asked to explain if others were surprised at her choice of teaching secondary IT as a career, one offered "Yes," adding that*: I would assume it's to do with my demeanour and looks. Female who isn't the dowdy geek in glasses (:P) and can communicate.* [Felicity]

These young women are training to be IT teachers thus trying to reconcile two competing narratives about identity. Their responses are corroborated by the findings of a number of research studies, most notably family support (von Hellens & Nielsen, 2001) and an almost unanimously held view of the IT industry as isolating and lacking in social interaction with others (Rettenmayer, Berry, & Ellis, 2007; Tapia & Kvasny, 2004; Varma, 2007; Wajcman, 1991, 2004).

The study described in this paper was based on three over-arching questions to determine what made these young women special, and seemingly atypical in their competence and confidence in their use of IT. In this, they are much closer to the feisty individuality of the emergent "girlpower" identity (Harris, 2003). The following attempts to draw some conclusions based around the questions addressed by the study described in this paper.

So, why IT?
The conclusion from this study was that, generally for these young women, an interest in IT was sparked (at home or school) and sustained and supported (at home). This typically began when they were quite young, and the presence of the computer in their homes from when they were 7 or 8 years of age would appear to be significant. While appearing to be an easy formula for the social engineering of future IT-savvy females, this finding may also be an historical accident. When these young women were 7 or 8 (and one at 13) in the late-80s and mid-90s when computers were quite "user-unfriendly." The clue is in the reporting of "old DOS games," the Commodore 64, and the need to type in BASIC commands in order to play games. This indicates a world of cassettes and command line interfaces, and where a computer user was (by default) a programmer. It must be noted that the computing experiences of parents and children now must, by virtue of the changes in technology, be vastly different.

There were similarly reports of support from fathers or siblings encouraging an interest and familiarity with technology. Mothers or female relatives were rarely mentioned in these reports indicating an early gendering of computers and "gadgets" as male and an activity mentored almost exclusively by males.

There were some rare exceptions to notion of familial support. One subject, Kate commented (in conversation) that her parents were "computer illiterate" and that they didn't understand what she was doing. Her support has come from her schooling and her own drive. There is also some evidence of the influence of single-sex schooling in engendering and encouraging competence and confidence in IT. This cannot, however, be regarded as a clear finding of this study because of its incidental reporting and of the low sample size.

So, why teaching?
Those who had chosen the double degree had made a conscious decision to combine these careers. All had begun with the intention of becoming a teacher although Bridget now believed that teaching was a "lesser choice" and while she intended finishing her education degree, had no intention of teaching in a school. Heather had education as the "fall back" position and had been wondering if she should opt for the corporate path, but had since become convinced that teaching was the better option for her because of its intrinsic rewards. This was despite her family's opposition.

For the young women in the Bachelor of Education cohort, they wanted to be teachers first, and IT popped up as their choice when specialisations had to be decided. All B.Ed students wrote of teaching in positive ways emphasising the role of the teacher as an agent of social change. They were teachers first, and IT experts second. The exception was Kate who ended up in teaching when she did

not get into the IT course she had planned. Changing her degree and career direction was a major step to her reinventing her own identity.

The dilemma the young women were experiencing can be represented as a simple quadrant diagram (Figure 2).

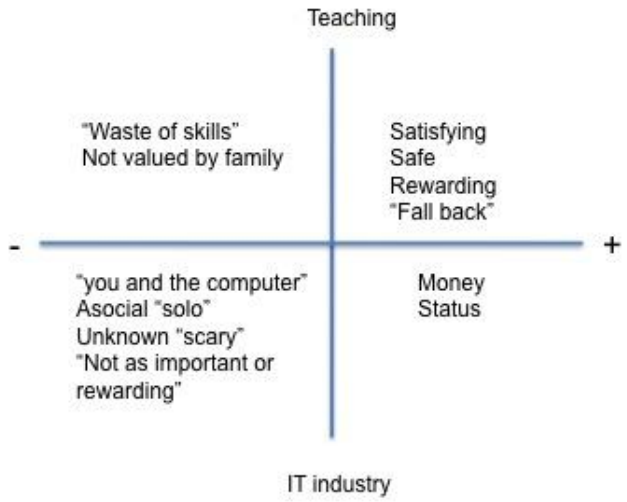

Figure 2: Positive and negative perceptions of IT teaching and the IT industry

This study set out to take a snapshot of the young women involved in one of the few growth areas for women in IT, that is, the micro-climate of IT teaching. Theirs is a valid career choice, and one that is arguably vital to redress some of the current issues of under-representation of girls in secondary computer studies. To do this, they have to counter a number of discriminatory stereotypes including the status of teaching itself, as well as the notion of IT as a male domain. A corollary aim was to ask the students to confront these stereotypes through the action of completing the survey. Through this process, three of the young women in the study – Kate, Bridget and Heather – wrestled with the dilemma till they found a path that fitted their own identities and matched their aspirations. The "wrestling" was evident in reflective comments such as:

> I'm still debating. IT industry could be interesting and left-field, and could offer increased financial gain. However I really enjoy the interaction with people and students. I enjoy the style of work, relationships with colleagues and have always thought of a career in teaching. [Felicity]

Conclusion

The young women surveyed were in tune with the worlds they inhabited. The male-female dichotomy and stereotypes of both the IT industry and teaching were not lost on them. They knew they were not typical young women or even typical teachers. They had experienced the mild shock of others when they

learnt of their career preparation, and seemed to enjoy the frisson of upsetting stereotypes. They were forceful and determined to deal with others' reactions through being pro-active. Further to this, they were critical of other women who used their gender as a "cop-out" and would presumably take this feisty attitude with them into the classroom becoming active role models for the girls they will teach in either single-sex or co-ed classes.

Above all, the findings from this study would indicate that these young women – as geek goddesses - are thoroughly equipped with the skills and dispositions to choose either careers in IT or teaching. They are not quite prepared to conform to any existing stereotype but to create new and vibrant identities for themselves. Epitomising models of girlpower, they are not prepared to stay away from technology because they are female; neither are they prepared to stay away from teaching because they are confident or tech-savvy. They seem determined to chart a path between the male-female dichotomies of their new careers and participation in the survey and attendant conversations has worked to focus their resolve. It can only be hoped that these young women are part of the solution to low female representation in IT as they become role models to the girls they will soon be teaching.

References

AAP. (2006). Geek goddesses or calendar girls? *The Sydney Morning Herald,* July 9, 2006. Retrieved December 10, 2008, from http://www.smh.com.au/articles/2006/07/09/1152383607217.html

ABS (Australian Bureau of Statistics). (2009). Schools, Australia 2008 [4221.0]. Retrieved August 11, 2009, from http://www.abs.gov.au/Ausstats/ABS@.nsf/Latestproducts/4221.

Adya, M., & Kaiser, K. (2005). Early determinants of women in the IT workforce. A model of girls' career choices. *Information, Technology & People, 18*(3), 230-258.

Agosto, D. (2001). Propelling young women into the cyber age: Gender considerations in the evaluation of Web-based information. *School Library Media Research. 4.* Retrieved July 28, 2009, from http://www.ala.org/ala/mgrps/divs/aasl/aaslpubsandjournals/slmrb/slmrcontents/volume42001/agosto.cfm

Agosto, D., Gasson, S., & Atwood, M. (2008). Changing mental models of the IT professions: A theoretical framework, M. (2008). Changing mental models of the IT professions: A theoretical framework. *Journal of Information Technology Education, 7,* pp. 205-221.

Apple. M. (1985). Teaching and 'women's work': A comparative historical and ideological analysis. Teachers College Record, LXXXVI (Spring), 457-473.

Baird, J. (2000, December 4). Geek image is putting women off jobs in IT [Web document]. *Sydney Morning Herald.* Retrieved September 12, 2004, from http://www.smh.com.au/news/0012/04/text/national10.html

Barker, L. J. & Aspray, W. (2006). The state of research on girls and IT. In Aspray, W., & Cohoon, J. M. (Eds.) *Women in information technology: Research on under-*

representation (pp. 4-54). Cambridge, MA: MIT Press.
Bennett, B. (2000). Australian women shun IT work. *Australia.Internet.com.* Retrieved September 12, 2004, from http://australia.internet.com/r/article/jsp/sid/190540
Beyer, S., Rynes, K., & Haller, S. (2004). Deterrents to women taking computer science courses. *IEEE Technology and Society, 23*, 21-28.
Chen Christensen, N. (2006). Geeks at play: Doing masculinity in an online gaming site. *Reconstruction 6.1.* Retrieved July 14, 2009, from http://reconstruction.eserver.org/061/christensen.shtml
Cohoon, J.M., && Aspray, W. (2006): *Women and Information Technology: Research on Underrepresentation.* Cambridge, MA: MIT Press.
Eubanks, V. (1995/2000). *Paradigms and perversions: A women's place in cyberspace.* PCSR Newsletter, 18(1). Retrieved September 7, 2008, from http://www.brillomag.net/No1/letter.htm
Gannon, S. (2007). Laptops and lipsticks: Feminising technology. *Journal of Learning, Media and Technology, 32*(1), 53 – 67.
Harris, A. (2003). gURL scenes an grrrl zines: The regulation and resistance of girls in late modernity. *Feminist Review, 75*, 38-56.
Heidensohn, F. (1994). 'We can handle it out there': Women officers in Britain and the USA and the policing of public order. *Policing and Society,* 4, 293-303.
Jepson, A., & Perl, T. (2002). Priming the pipeline. *Inroads SIGCSE Bulletin, 34*(2), 36-39.
Kekelis, L.S., Ancheta, R.W., & Countryman, J. (2005). Role models make a difference: A recipe for success. *AWIS Magazine, 34*(3), 17-24.
Lloyd, M. (in press, accepted April, 2009). She who can, teaches. In L. Beaudin & J. Morrison (Eds.), *Hard and soft technologies: Stories of women and technology*. Toronto, Canada: Women's Press.
Margolis, J., & Fisher, A. (2002). Unlocking the clubhouse: Women in computing. Cambridge, MA. MIT Press.
McCulloch, J., & Schetzer, L. (1993). Brute force: The need for affirmative action in the Victorian police force. *Australian Feminist Law Journal, 1*, 45-62.
NSW-DfW (2001) *Girls in IT Choices.* Sydney: NSW Department of Women.
Perelman, D/ (2007, March 16). Report: Tech's gender gap widened by uninviting workplace. *ACM Tech News.*
Ramsey, N., & McCorduck, P. (2005). Where are the women in information technology? Retrieved January 15, 2009, from http://anitaborg.org/files/abi_wherearethewomen.pdf
State of Victoria. (2001). *Reality bytes. An in-depth analysis of attitudes about technology and career skills.* Melbourne, Vic: Multimedia Victoria.
State of Victoria. (2007). *ICT skills research. Attitudes to ICT careers and study among 14-19 year old Victorians (Years 9-12).* Melbourne, Vic: Multimedia Victoria.
Tapia, A., & Kvasny, L. (2004). Recruitment is never enough: retention of women and minorities in the IT workplace. Proceedings of the ACM Conference on Computer Personnel Research: Careers, Culture, and Ethics in a Networked Environment, 84-91, Tucson, AZ.
Thomas, J. (2003). Musings on critical ethnography, meanings, and symbolic violence. In R.P. Clair (Ed.), *Expressions of ethnography* (pp. 45-54). Albany, NY: SUNY Press.

Thomas, R., & Allen, A. (2006). Gender differences in students' perceptions of information technology as a career. *Journal of Information Technology Education, 5*(5), 165-178.

Timms, C., Courtney, L., & Anderson, N. (2006). Secondary girls' perceptions of advanced ICT subjects: Are they boring and irrelevant? *Australian Educational Computing, 21*(2), 3-8.

Trauth, E.M., Nielsen, S., & von Hellens, L. (2003). Explaining the IT gender gap: Australian stories for the new millenium. *Journal of Research and Practice in Information Technology, 35*(1), 7-20.

Turkle, S. (1988). Computational reticence: Why women fear the intimate machine. In C. Kramarae (Ed.). *Technology and women's voices: Keeping in touch* (pp. 41-61). New York: Routledge & Kegan Paul.

Varma, R. (2007). Women in computing: The role of geek culture. *Science as Culture, 16*(4), 359-376

von Hellens, L. & Nielsen, S. (2001) Australian Women in IT. *Communications of the ACM, 44*(7), 46-52.

Wajcman, J. (1991) *Feminism confronts technology.* Cambridge: Polity Press.

Wajcman, J. (2004). *TechnoFeminism.* Cambridge: Polity Press.

Wardle, C., & Burton L. (2002). Programmatic efforts encouraging women to enter the information technology workforce. *SIGCSE Bulletin, 34*(2), pp. 27-3.